

SNAP TECHNICAL BACKGROUND DOCUMENT:

**RISK SCREEN ON THE USE OF
SUBSTITUTES FOR CLASS I
OZONE-DEPLETING SUBSTANCES:**

AEROSOLS

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NOTICE

This background document supports the U.S. Environmental Protection Agency's (EPA) rulemaking for controlling the replacement of Class I ozone-depleting substances (ODSs) with any substitute that presents unacceptable risk to human health or the environment where safer alternatives are available. Specifically, this document examines the risk from the use of various aerosol substitutes. Similar documents address other industry sectors.

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EXECUTIVE SUMMARY

This report presents a screening assessment of human health risks from the use of potential substitutes for ozone-depleting substances (ODSs) in the aerosol sector.¹ ODSs are being phased out of production in response to a series of diplomatic and legislative efforts that have taken place in the past few years, including the Montreal Protocol and, more recently, the Clean Air Act Amendments of 1990. The analyses presented in this report support the United States Environmental Protection Agency's Significant New Alternatives Policy (SNAP) Program, which is authorized by Section 612 of the Clean Air Act Amendments. Implementation of this program involves: (1) developing, promulgating, and administering a regulatory program for identifying and evaluating substitutes, and (2) publishing a list of acceptable and unacceptable substitutes for specific end uses.

The remainder of this summary provides an overview of ODS regulations and current use in the aerosol sector, the methodology used to conduct the risk screening analysis, and the key results.

ES.1 REGULATORY FRAMEWORK

In 1978, EPA and the Food and Drug Administration (FDA) banned all propellant uses of CFCs in aerosol products. However, some essential CFC aerosol products, such as products used in medical applications, were exempted from the ban, and some pressurized dispensers containing CFCs as the only ingredient were excluded because they did not meet the narrow definition of "aerosol propellant." CFCs used as solvents or as active ingredients were also excluded.

In Section 610 of the Clean Air Act Amendments (CAA) of 1990, Congress directed EPA to promulgate regulations that prohibit the use of nonessential consumer products that release Class I substances, effective November 15, 1992.² In the notice of proposed rulemaking, EPA proposed to ban all aerosol products and pressurized dispensers containing CFCs as nonessential products.³ EPA also proposed to exempt medical products and certain industrial products using CFCs as solvents.

Congress has also directed EPA to promulgate regulations, effective January 1, 1994, that prohibit the sale or distribution of any aerosol product or other pressurized dispenser containing a Class II compound. Congress has authorized EPA to grant exceptions to the ban where the product is deemed "essential" or where the only available alternative to the use of a Class II substance is a legally permitted use of a Class I substance.

Because of these controls on ODSs in aerosols and because of the general phaseout of Class I chemicals, rapid substitution for ODSs in the aerosols sector is expected.

ES.2 CURRENT USAGE OF ODSs IN AEROSOLS

In 1990, ODS use in the aerosols sector accounted for approximately two percent of total ozone depletion potential (ODP)-weighted emissions in the U.S. Currently, the ODSs used in the aerosols sector are:

¹ Other ODS sectors evaluated in separate reports are refrigeration and air conditioning; solvent cleaning; foam blowing; fire extinguishing; sterilization; and adhesives, coatings, and inks.

² Class I substances include CFCs, halons, methyl chloroform (MCF) and carbon tetrachloride.

³ 57 *Federal Register* 1992, January 16, 1992.

- CFC-12, CFC-114, HCFC-22, and HCFC-142b in propellant applications; and
- CFC-11, CFC-113, MCF, and HCFC-141b in solvent applications.

This background document evaluates substitutes for HCFC-22, the most widely used ozone-depleting propellant in aerosol and pressurized dispenser products, and substitutes for CFC-11, CFC-113, and MCF in solvent applications. Substitutes for CFC-12 and CFC-114 are not evaluated because these compounds are used primarily in medical applications and are therefore exempt from the Class I ban. Substitutes for HCFC-142b and HCFC-141b are not examined because the consumption of these substances is low.

ES.3 RISK SCREENING METHODOLOGY

To examine risks associated with the use of substitutes for ODSs in each sector, EPA examined many different types of exposure routes, receptors, and effects. As discussed in more detail later, EPA used an atmospheric modeling framework to assess global ozone depletion and associated health effects.

To examine risks to workers, consumers, and the general population, EPA first conducted screening-level analyses using generally conservative assumptions to identify scenarios potentially of concern, and then conducted more in-depth assessments of those scenarios. These risk assessments were conducted in three basic steps:

- (1)Assess exposure. EPA estimated levels of substitutes to which workers, consumers, the general population, and environmental receptors may be exposed, and over what period of time.
- (2)Evaluate toxicity. EPA developed information on the toxicity of each substitute, including occupational exposure limits, reference concentrations, and cancer slope factors. These values were identified from an appropriate source (e.g., Permissible Exposure Limits [PELs] from the Occupational Safety and Health Administration [OSHA]) or were derived for this report using extrapolation and other techniques.
- (3)Estimate risk. Exposure assessment results were combined with toxicity values to estimate risks. Uncertainties in the risk estimates were analyzed qualitatively.

EPA did not estimate risks for every possible combination of substitute, end use, and type of effect; combinations that clearly were not of concern were not analyzed. For example, substitutes that volatilize quickly when exposed to the atmosphere were not examined for potential releases to streams and effects on aquatic life. EPA believes that all of the significant human health and environmental exposure pathways and effects were covered in the risk screening analysis.

Below are brief descriptions of how the general approach discussed above was applied to the risk screen for the aerosol sector. Consumer risks were not analyzed because few consumer aerosol and pressurized dispensers currently contain ODSs. Aquatic toxicity was not assessed because releases of aerosol propellants and solvents to streams and waterways is negligible.

Atmospherics. EPA used the Atmospheric and Health Effects Framework (AHEF) to model the effects of propellant and solvent substitutes for ODSs in the aerosol sector. The framework employs the Venting Model for forecasting consumption and emissions of propellant and solvent substitutes. The Atmospheric Stabilization Framework (ASF) then uses the emissions data as input to predict changes in stratospheric ozone levels associated with changes in atmospheric condition. Changes in UV-B flux are then estimated from the ASF output. Finally, AHEF uses a human health effects model to calculate skin cancer cases and fatalities.

In this analysis two different baselines were employed to present the atmospheric impacts associated with each substitute in a given end use: an "ideal" or "no-risk" baseline, and a "no-substitution" baseline. These two baselines bound the range of health effects, since the first examines the impacts from a risk free scenario and the second presents effects assuming continued use of all CFCs. These baselines can be summarized as follows:

"Ideal" Baseline: This baseline presents the incremental ozone depletion risks associated with the use of each substitute in a given end use relative to a hypothetical substitute with an ODP of zero. In essence, this baseline presents the increase in ozone depletion risks that could result from the use of these substitutes relative to a no-risk baseline.

No-Substitution Baseline: Under this baseline, the incremental performance of each substitute within an end use is judged against continued use of Class I and Class II substances. In essence, this baseline presents the reduction in ozone depletion risks associated with phasing out the currently used ODSs in a given end use and switching to each of the potential substitutes.

It is important to note that the choice of baselines affects the presentation, and not the substance, of the results. Under either baseline, the relative differences among the substitutes with respect to ozone depletion are the same.

Worker Exposure and Risk. EPA used a mass-balance model to estimate worker exposure to propellant and solvent substitutes for ODSs used in industrial applications of aerosol products. EPA used personal sampling data obtained from OSHA and NIOSH for predicting occupational exposure levels during aerosol can-filling operations. Estimated exposures in the industrial use and manufacture of propellant substitutes were compared to occupational exposure limits to assess the potential risks to workers. Because some substitutes are flammable, EPA also screened these risks.

General Population Exposure and Risk from Ambient Air Releases. To estimate risks to the general population, EPA considered releases from two types of facilities: a manufacturing facility that produces aerosol products and an industrial facility that uses aerosol products. For each type of facility, EPA estimated annual emissions and then multiplied these emissions by generic dispersion factors generated by the Industrial Source Complex Long Term (ISCLT) model⁴ to predict fence-line concentrations of substitutes in air downwind of these facilities. These concentrations were then compared to health-based reference concentrations (RfCs) to assess noncancer health risks. For carcinogens, cancer risks associated with exposure to the predicted fence-line concentrations were calculated using EPA's standard risk equation.

VOCs. EPA compared VOC emissions from aerosol products to total VOC emissions from manufacturing facilities, households, and industrial sites on both the national and regional levels, assuming that ODSs currently used in aerosol products will be completely replaced by VOCs.

ES.4 RISK SCREENING RESULTS

Propellant Applications

EPA screened potential risks posed by five types of propellant substitutes:

⁴ The ISCLT model was developed by EPA for use in estimating exposures to atmospheric releases of pollutants from different types of sources.

- Hydrocarbons;
- HFCs (HFC-125, HFC-134a, and HFC-152a);
- A blend of HFC-152a and dimethyl ether (DME);
- Compressed gases; and
- Not-in-kind systems.

Because EPA has yet to define the aerosol applications using Class II substitutes that may be exempted from the Section 610 prohibition, continued use of HCFC-22 as a propellant was also evaluated. Results are summarized in Exhibit ES-1 and discussed below.

Atmospherics. Substitutes for propellant aerosol applications do not contain chlorine or bromine and therefore do not contribute directly to ozone depletion. Instead, predicted health effects of substitutes compared to the "ideal" baseline are due to the continued use of ODSs from 1992 to the time that the substitutes reach maximum penetration in the market. As none of the potential substitutes are ozone depleters, substitution of ODSs with any of the alternatives results in a marked decrease in skin cancer cases and fatalities when compared to the "no- substitution" baseline.

Worker Exposure and Risk. Substitutes for propellant uses are not expected to pose significant health risks to workers. Although hydrocarbons and HFC-152a are flammable, potential safety concerns can be mitigated by installing proper ventilation equipment and avoiding sources of ignition in the workplace. DME is also flammable, but the flammability characteristics of the HFC-152a/DME formulation screened in this report are not well understood.

General Population Exposure and Risk from Ambient Air Releases. Propellant substitutes pose very low potential for noncancer health effects. Lifetime cancer risk from exposure to HCFC-22 was calculated as 1.1×10^{-5} and is considered to be of low concern. General population exposure to HCFC-22 from aerosols will diminish significantly around January 1, 1994, when the Clean Air Act restricts HCFC use in aerosols.

VOCs. The analysis indicated that VOC emissions from substitutes for ODSs used in the aerosol sector are likely to be insignificant relative to VOC emissions from other sources.

Solvent Applications

EPA screened potential risks to human health posed by the following substitutes for ODSs in solvent applications:

- HCFC-141b;
- Petroleum-based hydrocarbons;
- Oxygenated hydrocarbons;
- Chlorinated solvents;

EXHIBIT ES-1: SUMMARY OF RESULTS OF RISK SCREEN FOR PROPELLANT SUBSTITUTES

SUBSTITUTE	ATMOSPHERICS^a			WORKER EXPOSURE	GENERAL POPULATION EXPOSURE	VOCs
	Baseline:	Ideal	No-Sub.			
Hydrocarbons	Cancer Cases: Cancer Deaths:	100 100	-26,200 -300	Not of concern	Not of concern	Small compared to overall emissions
HFC-125	Cancer Cases: Cancer Deaths:	100 100	-26,200 -300	Not of concern	Not of concern	NA
HFC-134a	Cancer Cases: Cancer Deaths:	<100 100	-26,200 -300	Not of concern	Not of concern	NA
HFC-152a	Cancer Cases: Cancer Deaths:	<100 100	-26,200 -300	Not of concern	Not of concern	NA
HFC-152a/ DME	Cancer Cases: Cancer Deaths:	<100 100	-26,200 -300	Not of concern	Not of concern	Small compared to overall emissions
Compressed Gas	Cancer Cases: Cancer Deaths:	100 100	-26,200 -300	Not of concern	NA	NA
Not-in-Kind	Cancer Cases: Cancer Deaths:	100 100	-26,200 -300	Not of concern	NA	NA

NA = Not applicable

^a Skin cancer cases and fatalities presented in this table represent the changes in cases and fatalities relative to an "ideal" baseline (a hypothetical substitute with no ozone depletion potential) and a "no substitute" baseline (continued use of the ODS). For the "ideal" baseline, the hypothetical substitute is assumed to fully penetrate the aerosols market in 1992, while the substitutes are assumed to begin to penetrate the market in 1993. Predicted health effects, therefore, reflect both continued use of ODSs prior to full penetration of these substitutes as well as any ozone depleting effects of the substitutes listed.

- Terpenes; and
- Water-based systems.

The results of this risk screening analysis are summarized in Exhibit ES-2 and discussed below.

Atmospherics. The model predicted that, compared to the "ideal" substitute baseline, HCFC-141b would be the largest contributor to atmospheric chlorine loadings when substituted for CFC-11, CFC-113, or MCF. As a result, its use would contribute to more skin cancer cases and cancer fatalities than other substitutes. When HCFC-141b was substituted for CFC-11, the model predicted 500 more cancer cases than the other substitutes; when substituted for CFC-113, the model predicted an additional 900 skin cancer cases; and when HCFC-141b replaced MCF, the model predicted an additional 23,300 cancer cases.

Worker Exposure and Risk. Occupational exposures to solvent substitutes do not generally exceed established exposure limits during the manufacture or industrial use of aerosol products. In those instances where predicted exposures exceed occupational exposure limits, the addition of local exhaust ventilation will likely reduce levels to within acceptable exposure limits. Petroleum-based hydrocarbons and oxygenated hydrocarbons are flammable, but potential safety concerns can be mitigated by installing proper ventilation equipment and removing flammable aerosols from areas with ignition sources.

General Population Exposure and Risk from Ambient Air Releases. EPA's risk screen indicates that the industrial use of chlorinated solvents is potentially of concern for general population exposure and risk. The estimated cancer risks from releases of chlorinated solvents to air may exceed levels historically regulated by EPA. Title III of the Clean Air Act lists trichloroethylene, perchloroethylene, and methylene chloride as hazardous air pollutants (HAPs) and provides EPA with the authority necessary to establish controls for their use.

VOCs. As discussed above, the analysis indicated that VOC emissions from substitutes in the aerosols sector are likely to be small compared to VOC emissions from other sources.

EXHIBIT ES-2: SUMMARY OF RESULTS OF RISK SCREEN FOR SOLVENT SUBSTITUTES

SUBSTITUTE	ATMOSPHERICS ^a							WORKER EXPOSURE ^b	GENERAL POPULATION EXPOSURE	VOCs
	Substitute for:	CFC-11		CFC-113		MCF				
	Baseline:	Ideal	No Sub.	Ideal	No Sub.	Ideal	No Sub.			
HCFC-141b	Cancer Cases: Cancer Deaths:	1,400 100	-69,900 -1,100	2,400 100	-96,900 -2,100	27,300 600	-560,100 -10,500	Not of concern	Not of concern	Small compared to overall emissions
Petroleum-Based Hydrocarbons	Cancer Cases: Cancer Deaths:	900 <100	-70,400 -1,200	1,500 <100	-97,800 -2,100	4,000 100	-583,400 -10,500	Not of concern	Not of concern	Small compared to overall emissions
Oxygenated Hydrocarbons	Cancer Cases: Cancer Deaths:	900 <100	-70,400 -1,200	1,500 <100	-97,800 -2,100	4,000 100	-583,400 -10,500	Not of concern	Not of concern	Small compared to overall emissions
Chlorinated Solvents	Cancer Cases: Cancer Deaths:	900 <100	-70,400 -1,200	1,500 <100	-97,800 -2,100	4,000 100	-583,400 -10,500	Addressed by OSHA PELs	EPA may control estimated risk under Title III of the CAA	Small compared to overall emissions
Terpenes	Cancer Cases: Cancer Deaths:	900 <100	-70,400 -1,200	1,500 <100	-97,800 -2,100	4,000 100	-583,400 -10,500	Not of concern	Not of concern	Small compared to overall emissions
Water-based Systems	Cancer Cases: Cancer Deaths:	900 <100	-70,400 -1,200	1,500 <100	-97,800 -2,100	4,000 100	-583,400 -10,500	Not of concern	Not of concern	NA

NA = Not applicable

^a Skin cancer cases and fatalities presented in this table represent the changes in cases and fatalities relative to an "ideal" baseline (a hypothetical substitute with no ozone depletion potential) and a "no substitute" baseline (continued use of the ODS). For the "ideal" baseline, the hypothetical substitute is assumed to fully penetrate the aerosols market in 1992, while the substitutes are assumed to begin to penetrate the market in 1993. Predicted health effects, therefore, reflect both continued use of ODSs prior to full penetration of these substitutes as well as any ozone depleting effects of the substitutes listed.

^b While EPA's occupational exposure model predicted that some solvent substitutes used in industrial applications would exceed OSHA PELs or EPA OELs under conditions of no ventilation, it is likely that the addition of local exhaust ventilation will reduce exposure concentrations to within acceptable limits.

1. INTRODUCTION

This report documents the results of the examination of human health risks from the use of substitutes for ozone-depleting substances (ODSs) in the aerosols sector.⁵ This introduction provides a brief background on the history and philosophy of the Significant New Alternatives Policy (SNAP) program, discusses in general terms the types of analyses performed to screen risks from the substitutes, and provides a list of the chapters that follow.

1.1 BACKGROUND

Over the past decade, a series of diplomatic and legislative efforts have taken place in response to growing concerns over the progressive depletion of the Earth's stratospheric ozone layer and its attendant health and environmental problems. The first major step was in September 1987, when the United States and 23 other nations signed the Montreal Protocol. The original agreement established a schedule for reducing by half the production and consumption of eight specific ODSs, including chlorofluorocarbon (CFC)-11, CFC-12, CFC-113, CFC-114, CFC-115, Halon-1211, Halon-1301 and Halon-2402. When the parties to the Protocol met again in London in June 1990, they agreed to fully phase out the original eight ODSs, as well as methyl chloroform, carbon tetrachloride, and other fully halogenated CFCs.

Congress incorporated the requirements of the London Amendments into the Clean Air Act (CAA) Amendments of 1990, and in some cases went beyond the London requirements. Title VI of the CAA differs from the London Amendments by mandating a faster phaseout of methyl chloroform, a restriction on the use of hydrochlorofluorocarbons (HCFCs) after 2015, and a ban on the production of HCFCs after 2030. When the Parties to the Montreal Protocol met in Copenhagen in November 1992, they further accelerated the phaseout dates for many controlled substances. To implement the Copenhagen amendments and adjustments, EPA promulgated regulations in December 1993 that set the phaseout date at January 1, 1996 for Class I substances (as defined in the CAA), with the exception of halons which were subject to a phaseout by January 1, 1994. The regulation also includes a phaseout of methyl bromide by the year 2001.

Section 612 of the CAA requires EPA to develop a program to evaluate the risks to human health and the environment posed by alternatives to ODSs. EPA is referring to this new program as the SNAP program. The SNAP program is directed at fulfilling the general mandate in Section 612 of identifying acceptable and unacceptable substitutes for the Class I ODSs. Initial SNAP implementation involves two key activities: (1) developing, promulgating, and administering a regulatory program for identifying and evaluating substitutes; and (2) publishing a list of acceptable and unacceptable substitutes for specific end uses.

⁵ Other sectors evaluated in separate reports are refrigeration and air conditioning; solvent cleaning; foam blowing; fire extinguishing; sterilization; and adhesives, coatings, and inks.

EPA took the first major step in implementing Section 612 of the CAA on January 16, 1992, with publication of a Request for Data and Advance Notice of Proposed Rulemaking (ANPRM; 57 *Federal Register* 1984). This notice, developed with the help of the Stratospheric Ozone Protection Advisory Committee (STOPAC), presented the initial plan for implementing the SNAP program and requested producers and formulators of substitutes for ODSs to provide EPA with information to facilitate review of the substitutes. A Notice of Proposed Rulemaking was published in the Federal Register on May 12, 1993. The proposed rule described the proposed structure and process for administering the SNAP program and presented initial determinations on the acceptability of key substitutes. This Final Rule provides both the SNAP process and additional SNAP determinations on the acceptability of substitutes. In the future, substitutes will be addressed on a case-by-case basis through individual notices. In addition, EPA will accept petitions requesting that a substance be added or deleted from either of the lists.

1.2 EVALUATION OF SUBSTITUTES

To develop the lists of unacceptable and acceptable substitutes, EPA conducted a screening assessment of the health and environmental risks posed by various substitutes in the context in which they are used. Substitutes are grouped into one or more of eight general sectors: refrigeration and air conditioning; solvent cleaning; foam blowing; fire extinguishing; aerosols; sterilization; and adhesives, coatings, and inks; and tobacco expansion. Within each sector, substitutes are evaluated in the context of particular end uses. In the aerosols sector, substitutes can be used as propellants and solvents in applications such as noise horns, tire inflators, and cleaning sprays. EPA also determined the feasibility of using each substitute by assessing its production capacity and projected market share. Based on these analyses, EPA will identify as "unacceptable" only those substitutes that pose significantly higher human health and environmental risks than other available substitutes. EPA does not intend to restrict substitutes that are only marginally worse based on some criteria.

EPA's evaluation of each substitute in each end use is based on the following types of information and analyses:

- **Atmospheric effects** are assessed by using models to predict stratospheric ozone depletion. Ozone depletion is measured in terms of cumulative Cl_x loadings and increased incidence of skin cancer cases and skin cancer mortalities. Changes in global temperatures may result from releases of the substitutes themselves or from changes in fossil fuel use due to increases or decreases in energy efficiency. These impacts are discussed qualitatively.
- **Exposure** assessments are used to estimate the levels of substitutes to which workers, consumers, the general population, and environmental receptors may be exposed, and over what period of time such exposure may take place. These assessments are based on personal monitoring data or area sampling data if available. Otherwise, exposures are assessed using measured or estimated releases as inputs to mathematical models. Exposure assessments may be conducted for many types of releases, including releases in the workplace and in peoples' homes, releases to ambient air and surface water, and releases from the management of solid wastes.
- **Toxicity** data are used to screen the possible health and environmental effects from exposure to the substitutes. If Occupational Safety and Health Administration (OSHA)-approved or EPA-wide health-based criteria such as Permissible Exposure Limits (PELs; for occupational exposure), reference concentrations (RfCs; for noncarcinogenic effects), or cancer slope factors (for carcinogenic risk) are available for a substitute, exposure information is combined with this toxicity information to determine whether there is potential for concern. Otherwise, toxicity data are used in conjunction with existing EPA guidelines to develop health-based criteria for interim use in these risk screens.

- **Flammability** is examined as a possible safety concern for workers and consumers. EPA screens flammability risk using data on flash point and flammability limits (e.g., OSHA flammability/combustibility classifications), test data on flammability in consumer applications conducted by independent laboratories (e.g., Underwriters Laboratories), and information on flammability risk minimization techniques.
- Some of the proposed substitutes are **volatile organic compounds (VOCs)**, which are chemicals that increase tropospheric air pollution by contributing to ground-level ozone formation. Local and nationwide increases in VOC loadings from the use of substitutes are also evaluated.

In conducting these assessments, EPA made full use of previous analyses, including the 1990 interim assessments prepared by EPA's Office of Pesticides and Toxic Substances and the supporting documentation (full citations are given in the appropriate chapter of this report). These analyses were modified in some cases to incorporate more recent data or new field experience. Where possible, EPA incorporated data submitted in response to the ANPRM and NPRM. Finally, these analyses assume that the regulated community is in compliance with applicable requirements of other statutes and regulations administered by EPA (e.g., recycling requirements promulgated under the CAA) and other federal agencies (e.g., enforceable workplace standards set by OSHA).

1.3 RISK SCREENING ANALYSES FOR AEROSOL SUBSTITUTES

The remainder of this report includes chapters on the following topics:

- Overview of substitutes and end uses;
- Toxicity reference values for substitutes;
- Atmospheric modeling (ozone depletion, global warming);
- Occupational exposure and risk analysis;
- General population exposure and risk screening analysis; and
- VOC analysis.

Consumer risks were not analyzed because few consumer aerosol and pressurized dispenser products contain ODSs. Aquatic toxicity was not assessed because releases of aerosol propellants and solvents to streams and waterways is believed to be negligible. Flammability is addressed within several of the chapters. Compliance costs are addressed in conjunction with other SNAP decisions in a separate package, as are regulatory burdens and effects on small businesses.

Finally, three of the substitutes analyzed in this report, HCFC-123, HCFC-124, and HFC-134a contribute to or generate trifluoroacetic acid (TFA) as an atmospheric transformation product. The potential ecological effects on aqueous and terrestrial ecosystems are not addressed in this report because of insufficient data on the toxicity of TFA and the level to which ecosystems may be exposed. Research efforts of the Agency in cooperation with the Alternative Fluorocarbons Environmental Acceptability Study (AFEAS) are underway to define the potential ecological risks associated with the formation of TFA in the environment.

Although there are significant uncertainties about the potential risks associated with TFA, and research is continuing to address these risks, a number of preliminary statements can be made based on the research completed to date⁶:

⁶ See Alternative Fluorocarbons Environmental Acceptability Study (AFEAS). 1991. "Kinetics and Mechanisms for the Reactions of Halogenated Organic Compounds in the Troposphere." STEP-HALOCSIDE/AFEAS WORKSHOP, Dublin. May 14-16, 1991. See also AFEAS. 1993. "Production, Sales, and Atmospheric Releases of Fluorocarbons Through 1992."

- Research indicates that virtually 100% of the HCFC-123 and HCFC-124 released to the environment will degrade to TFA, and suggests that approximately 25% to 40% of HFC-134a will also degrade to TFA.
- TFA is a highly soluble acid that will exist primarily in aqueous environments (rain, rivers, lakes, ocean, and groundwater). Tests have shown that it is very resistant to decomposition and will therefore reside in the environment for long periods of time.
- Given conservative estimates of global HCFC and HFC use and emissions, the environmental concentrations of TFA will be low over the next few decades.
- Experimental results show at high concentrations TFA has low to moderate acute toxicity to animals and initial tests indicate that relatively high concentrations of TFA cause toxic effects on some plants and algae. Research to evaluate these effects is continuing.
- The expected environmental concentrations of TFA over the next few decades are unlikely to pose a significant hazard to animals or plants.
- There has been concern that TFA might degrade to MFA (monofluoroacetic acid) and that MFA could exist at high enough concentrations to pose health and environmental risks. Research to date has identified no environmental process that would convert TFA to MFA. Research to elucidate all the degradation pathways for TFA, including potential pathways to MFA is continuing.

EPA is closely monitoring the research efforts underway with respect to TFA, and will assess the long term ecological risks associated with this compound when the research is completed. As noted above, research completed to date has not uncovered any risks that warrant the implementation of measures to control atmospheric concentrations of TFA. If such risks are identified in the future, the Agency will re-assess its position on TFA and evaluate measures to mitigate such risks.